Municipal Sewage Regulation

Code of Practice for the Use of Reclaimed Water

A Companion Document to the Municipal Sewage Regulation

Issued May 2001

BRITISH COLUMBIA

Ministry of Environment, Lands and Parks
Pollution Prevention and Remediation Branch

Contents

1. General **1**

1.1 Purpose of This Document 1
1.2 Background 1
1.3 The Municipal Sewage Regulation 1
1.4 Roles and Responsibilities 1
1.5 Reclaimed Water in British Columbia 3
1.6 Glossary of Terms 4
1.7 Redundancy 5

2. Water Quality **6**

2.1 Categories of Water Quality 6

3. Using Reclaimed Water **7**

3.1 Irrigation 7
3.2 Chemical Spraying 13
3.3 Fire Fighting 13
3.4 Toilet and Urinal Flushing 14
3.5 Ponds and Decorative Uses 15
3.6 Stream Augmentation 15
3.7 Habitat restoration/enhancement 16
3.8 Commercial Vehicle, Driveway and Street Washing 17
3.9 Snow and Ice Making 18
3.10 Dust suppression and soil compaction 19
3.11 Industrial Uses 19

4. Urban Dual Distribution (Non-Potable) **21**

4.1 Preface 21
4.2 Roles and Responsibilities 21
4.3 References 21
4.4 Description of use 22
4.5 Design and Installation Requirements 22
4.6 Equipment Considerations 22
4.7 Design Considerations 24
4.8 System Management 24

5. Contingency Options For Surplus Reclaimed Water **25**

5.1 Subsurface disposal 25
5.2 Infiltration Basins 25
5.3 Surface Water Discharge (Outfall) 26
5.4 Evaporation Basins 26
5.5 Deep Well Injection 26

6. Storage **27**

6.1 Irrigation Purposes 27
6.2 Normal Balancing (Seasonal) Storage 28
6.3 Emergency Storage 28
6.4 Storage for Treatment 28

7. Monitoring **30**

7.1 Monitoring of Reclaimed Water Quality 30
7.2 Receiving Environment Monitoring 30

7.3 Preventive Measures 30

8. Labelling, Signage, and Fencing 31

8.1 Signage 31
8.2 Fencing 31

9. Records And Reporting 32

9.1 Maintenance of Records 32
9.2 Assessment of New Areas To Be Irrigated 32
9.3 Assessment of New Uses of Reclaimed Water 32
9.4 Annual Performance Report 32

10. Communications 34

10.1 Elements of a Communications Plan 35

11 Emergency Response Plan 36

11.1 Plan Contents 36
11.2 Potential Emergency Situations 36

12. Resources 37

12.1 BC Environment Regional and Headquarters Offices 37
12.2 BC Ministry of Agriculture, Food and Fisheries 38
12.3 Local Health Authorities 38
12.4 Websites 40
12.5 Other Reference Materials 41
12.6 List of Abbreviations 41

Disclaimer

The Municipal Sewage Regulation (MSR) provides the standards, requirements, and provisions for dischargers of municipal sewage to comply with the *Waste Management Act*. Compliance with the MSR does not necessarily ensure compliance with other federal (e.g. *Fisheries Act*), provincial, or municipal laws.

This Code for the Use of Reclaimed Water is meant as an aid in implementing and complying with the MSR. Users of this code should obtain a copy of the MSR from Crown Publications. If discrepancies between this code and the MSR exist, the MSR and its legal interpretations take precedence.

105-03612/

1. General

The general philosophy for the use of reclaimed water is that it be for beneficial purposes.

1.1 Purpose of This Document

This Code of Practice (the code) is intended to be a key reference and guidance document for the use of reclaimed water in British Columbia. It is designed to support the regulatory requirements prescribed in the Municipal Sewage Regulation (MSR) and should be used as a companion document to the MSR. Understanding and adhering to the MSR and the code should ensure that the use of reclaimed water protects human health and the environment and benefits British Columbians.

1.2 Background

The Ministry of Environment, Lands and Parks (MELP) developed the MSR in consultation with stakeholders as a comprehensive, progressive regulation governing all aspects of municipal wastewater management. The MSR allows the use of reclaimed water for many beneficial purposes.

1.3 The Municipal Sewage Regulation

Users of this code must be familiar with the standards and requirements of the MSR. Specifically, a thorough understanding of section 10, schedule 2 and the relevant portions of schedule 7 is essential. The MSR requires appropriate environmental impact studies. Users of this code should obtain the latest version of the *Environmental Impact Study Guideline*.

1.4 Roles and Responsibilities

End-users and providers of reclaimed water, technology suppliers, qualified professionals, and regulatory agencies all play important roles and have certain responsibilities to ensure that the use of reclaimed water is practised safely in compliance with the MSR.

End-users of Reclaimed Water

Informed end-users can play an important role in the successful use of reclaimed water. They can identify concerns regarding specific uses of reclaimed water and report them to local or provincial agencies. They can also contribute to the formation of local and provincial policies. By policy, MELP responds to all complaints received from the public. Local governments are encouraged to undertake liquid waste management planning, as well, which includes public consultation.

Providers and Purveyors of Reclaimed Water

The use of reclaimed water in BC is based on the assumption that its providers have a strong stewardship ethic and are prepared to exercise responsibility and accountability in protecting human health and the environment.

Providers of reclaimed water must comply with all applicable provincial and federal legislation including the MSR. They must also be familiar with and meet all of the requirements of the MSR and this code.

Providers must retain the services of appropriate qualified professionals as required under the MSR to ensure compliance. When retaining qualified professionals, they should use an appropriate selection process based on quality of service – not on price alone. The services of a qualified professional typically form a small portion of the lifecycle costs of a project and should also help to ensure the success of the undertaking.

If a local government provides reclaimed water under the MSR and the code, then it assumes the roles and responsibilities outlined here. Local governments must co-operate with provincial agencies in the implementation of the MSR and co-ordinate programs involving reclaimed water management whenever possible.

The *Waste Management Act* and the MSR provide other opportunities for local governments to be further involved in the management of municipal discharges, including the use of reclaimed water, by developing liquid waste management plans and local service areas. This flexible approach provides the opportunity for local governments to create innovative, local solutions for sewage collection, treatment, reuse, and discharge that are affordable and protect human health and the environment. Through the liquid waste management planning process, local governments are encouraged to foster water conservation and use of reclaimed water, and to establish source control programs.

Technology Suppliers

Technology suppliers are expected to provide wastewater treatment technologies that can meet the reclaimed water standards of the MSR and this code. This includes the construction, operation, and maintenance of treatment systems and associated services.

Qualified Professionals

This code and the MSR recognize and rely upon qualified professionals' responsibility and accountability in their areas of practice. Both assume these principles of professionalism as means to ensure compliance. This code also outlines the expectations of qualified professionals. These include the expectation to follow the precautionary principle while exercising responsibilities in projects that involve the use of reclaimed water under the MSR and this code. Qualified professionals are also expected to bring to the attention of the Regional Pollution Prevention Manager any situation within their area of expertise where the MSR or this code does not adequately protect human health or the environment, and to recommend protective measures that may be required.

Regulatory Agencies

MELP's role involves setting clear environmental protection standards and developing and implementing policies, procedures, and guidelines for compliance with these standards. The MSR specifies the standards that providers of reclaimed water must meet to protect human health and the environment. MELP promotes awareness of the MSR and this code to assist stakeholders in understanding their roles and responsibilities in implementing and complying with the MSR. MELP is also responsible for measuring compliance with the MSR and for appropriate enforcement action.

MELP will consult with local health authorities on issues relating to the use of reclaimed water. It is the responsibility of local health authorities, in consultation with Ministry of Health officials, to advise MELP and providers of reclaimed water so that standards are set and practices conducted to protect human health.

Moreover, MELP will consult with the Ministry of Agriculture, Food and Fisheries (MAFF) on issues relating to the use of reclaimed water on agricultural land and products. It is MAFF's responsibility to advise MELP and providers of reclaimed water, in consultation with the agricultural industry, so that standards are set and practices conducted to protect the quality of agricultural products.

1.5 Reclaimed Water in British Columbia

Compliance with the MSR and this code enable the use of reclaimed water in BC. The ability to use reclaimed water supports water conservation practices, community planning goals, and integration of water supply and wastewater infrastructure needs.

BC's Water Conservation Strategy

The use of reclaimed water supports BC's Water Conservation Strategy, which acknowledges that, as part of long-term planning, water-use efficiency measures can substantially contribute to:

- accommodating future economic development and population growth
- reducing or deferring costs of maintaining and expanding water delivery, treatment, and disposal systems
- reducing energy and maintenance costs
- ensuring sufficient water flow for in-stream and downstream extractive uses
- maintaining riparian habitats and aquatic ecosystems.

Through its cautious rules for the use of reclaimed water, the MSR provides for local governments and others to help address these long-term goals of water conservation.

Community Planning

A liquid waste management plan requires a comprehensive evaluation of all aspects of municipal liquid wastes and leads to a plan for their proper management. Developed using extensive public consultations and designed to compliment a community's Official Community Plan, Growth Management Plan, and other community planning efforts, a liquid waste management plan can be used to integrate cost-effective solutions to address various local liquid waste issues. These include:

- meeting water conservation goals
- developing strategies to minimize wastewater generation and maximize the use of reclaimed water
- protecting human health and the environment.

Approved Liquid Waste Management Plans give local governments more control over municipal liquid waste discharges within their communities, including projects for the use of reclaimed water.

Integration of Water Supply and Wastewater Infrastructure

Beneficial use of highly-treated reclaimed water could:

- reduce future potable water supply and treatment costs
- conserve water
- avoid additional disposal costs
- reduce discharges of effluent.

The MSR and this code's provisions for the use of reclaimed water should help communities integrate water supply and wastewater treatment needs to produce significant cost savings and important environmental benefits.

1.6 Glossary of Terms

beneficial
advantageous or helpful in enhancing the environment, increasing conservation of natural resources, or improving biological or physical processes without any negative impact on human health and the environment.

biosolids
organic and inorganic solid residuals from a sewage facility; recyclable septic tank sludge treated by a municipal sewage treatment process to reduce vector attraction and pathogens densities.

EC
a measure of salinity expressed in millimhos per centimetre (mmho/cm) or decisiemens per metre (dS/m) at 25° C.

effluent
the treated liquid discharge from a sewage treatment system. (N.B. *Sewage effluent* is a contradiction and an incorrect use of the terms *sewage* and *effluent*.)

municipal sewage
sewage, wastewater, or municipal liquid waste originating primarily from residences, possibly including input from holding tanks in recreational vehicles, boats, and houseboats; commercial, institutional, and industrial sources; or inflow and infiltration.

reclaimed water
effluent from a sewage facility considered suitable for a direct designated water use or a controlled use.

salinity
the saltiness of soil measured by electrical conductivity measured in decisiemens/m (ds/m) and by sodium adsorption ratio (SAR). Soils high in soluble salts are referred to as *saline*. A saline soil has an EC greater than 4 ds/m and a SAR of less than 13. Salinity affects the growth of many crops.

septic tank effluent
the treated liquid discharge from a septic tank.

sewage, **raw sewage**, or **domestic sewage**
human excretion; the water-carried wastes from liquid or non-liquid culinary purposes, washing, cleansing, laundering, food processing, or producing ice.

sewage treatment plant effluent
the treated liquid discharge from a sewage treatment plant.

sodicity
the effects a high sodium water source has on soil structure. Soil sodicity is measured by electrical conductivity in decisiemens/metre (ds/m) and by sodium adsorption ratio (SAR). A *sodic* soil has an EC of less than 4 ds/m and a SAR greater than 13.

sodium adsorption ratio (SAR)
a measure of the amount of sodium relative to the amount of calcium and magnesium in water or a soil solution. The SAR can be used to predict the exchangeable sodium percentage of a soil equilibrated with a given solution.

1.7 Redundancy

The generation and use of reclaimed water requires that all treatment systems and conveyance methods be reliable and robust. Providers of reclaimed water should ensure that appropriate levels of redundancy are built into and maintained for all system components. Providers of reclaimed water must also ensure that their management structures and communication procedures be designed and maintained to include redundancy so that they are robust enough to ensure consistent service quality and responsiveness to issues.

2. Water Quality

The MSR authorizes the use of reclaimed water for two different water quality standards, referred to here as *category 1* and *category 2*. The intent is to identify two different qualities of treated reclaimed water for various uses. This code provides guidance for conveying reclaimed water to intended customers, based on level of treatment, intended use, and operational practices.

2.1 Categories of Water Quality

The two categories of reclaimed water quality are founded on the basic principle of protecting public health. Section 10 of the MSR provides direction on the use of reclaimed water. That section refers to schedule 2, which provides standards for the use of reclaimed water in two categories.

Category 1: unrestricted public access

Category 1 reclaimed water is of a high enough standard that the MSR and the code allow public contact with it (e.g. public access to land irrigated with the reclaimed water).

The term *category 1* applies here to reclaimed water meeting the unrestricted public access category requirements of the MSR.

Category 2: restricted public access

Category 2 reclaimed water requirements are at a level more stringent than most discharge effluent standards, though the resulting quality still requires that the public be restricted from contact with it, including access to land irrigated with the reclaimed water.

The term *Category 2* applies here to reclaimed water that meets the restricted public access category requirements of the MSR.

Category 2 reclaimed water uses are limited to activities where:

- the public will not likely come into contact with the reclaimed water
- sufficient time has elapsed since treatment or use prior to public contact
- in the case of agricultural products, a commercial process has been applied to make the product safe for distribution.

Reclaimed water must be of the quality indicated in MSR schedule 2 (either category) to be used under the MSR. Schedule 2 (*Permitted Uses and Standards for Reclaimed Water*) specifies the level of treatment and effluent quality expected for the two categories. Uses of reclaimed water that differ from those outlined in schedule 2 of the MSR must be approved in writing by the Director after consultation with the Ministry of Health.

3. Using Reclaimed Water

This section discusses the various methods of applying reclaimed water for the various uses identified in the MSR. Some application methods use up the supply of reclaimed water while others are backups for when the supply of reclaimed water is not consumed by other means.

A provider of reclaimed water must prepare an operating plan that covers operational and maintenance details for the reclaimed water facility and associated backup options for surplus reclaimed water. A copy of the operating plan must be kept at the facility for inspection by the Regional Pollution Prevention Manager or her or his designate.

A hydrogeclogical assessment conducted by a qualified professional should address the on-site and off-site environmental impact of reclaimed water irrigation, including soil stability and erosion. The report must include recommendations as to the number and locations of groundwater sampling wells, including at least one *background* sampling well. Such an assessment might not be required by the Regional Pollution Prevention Manager.

3.1 Irrigation

Irrigation systems can be used to apply reclaimed water to crops in places with a moisture deficit during the growing season, for frost protection in the spring and autumn, and for crop cooling during hot times in summer.

The general philosophy is that the irrigation system must be designed and operated to maximize the beneficial use of reclaimed water and to minimize the need for effluent disposal to watercourses or the ground. This prevents excessive irrigation and subsequent negative impacts on irrigated lands and lands down-gradient from them.

3.1.1 References

This reference information should be used in the design and operation of irrigation systems used to apply reclaimed water:

- *The BC Sprinkler Irrigation Manual* (1989) – MAFF & IIABC
- *The BC Trickle Irrigation Manual* (1999) – MAFF & IIABC
- *Chemigation Guidelines for British Columbia* (1993) - MAFF
- *Irrigation System Cross Connection Control* - MAFF factsheet 578.130-1
- *BC Frost Protection Guide* (1988) - MAFF
- *Using Irrigation for Tree Fruit Cooling* (1995) - MAFF factsheet 578.300-1
- *Guide to Irrigation System Design with Reclaimed Water* - MAFF 595.000-1
- *Irrigation Scheduling Techniques* - MAFF factsheet 577.100-1
- *Irrigation Scheduling with Tensiometers* - MAFF factsheet 577.100-2
- *Evapotranspiration Rates for Turf Grass in BC* - MAFF factsheet 563.600-1
- *Determining the Irrigation Requirement for Turf and an Irrigation Schedule* – IIABC

3.1.2 Descriptions of Uses

Irrigation is the artificial application of water to the soil or a growing medium to sustain plant growth and/or optimize crop production. Irrigation systems applying reclaimed water can be used for silviculture, landscape systems, and a variety of agricultural operations including greenhouses.

Category 1 reclaimed water may be applied to food crops eaten raw, landscaping areas such as playgrounds, golf courses, cemeteries, residential lawns, greenhouses, and silviculture operations. Irrigation for frost protection and crop cooling is also allowed.

Category 2 reclaimed water may only be applied to agricultural crops that are processed or to vegetation such as pasture, fodder, nurseries, and silviculture operations. Landscapes may not be irrigated with this water. Orchards and vineyards irrigated with a drip irrigation system that does not contact the plant or crop may use this water. Spring frost protection is allowed but crop cooling and autumn frost protection are not.

Crop Irrigation

Agricultural irrigation may use a variety of irrigation system types, including sprinklers, drip or trickle, and subsurface drip.

- **Sprinkler Irrigation**

  Sprinkler systems use a spray pattern to distribute water to the crop. Sprinkler irrigation systems that can apply reclaimed water to agricultural crops include center pivot, handline, wheelmove, solid set overtree and undertree, microsprinklers, and travelling and stationary guns. The type of system selected depends on the crop to be grown, field shape, topography, and system management.

  The irrigation system must be designed and operated so that the application rate matches the crop water requirement throughout the growing season. An allowance for some leaching must also be incorporated to ensure that salt build-up in the soil does not occur. Correct selection of sprinkler spacing, nozzles, and operating pressure is necessary.

- **Drip/Trickle Irrigation**

  Drip/trickle irrigation systems use emitters to apply water directly to the plant rooting area. Water is applied at a low flow rate but in an amount sufficient to replenish the crop water requirements frequently, usually daily. Spray emitters that apply water only to the plant rooting area can be considered a trickle system. For more information see the *BC Trickle Irrigation Manual.*

- **Subsurface Drip Irrigation (SDI)**

  These drip systems are buried below the soil surface. This method of installation increases the volume of soil wetted by an emitter, improves crop yield and quality, reduces disease transfer, and reduces weed growth. The design, maintenance, and installation of SDI systems are different from surface systems. See chapter 6 of the *BC Trickle Irrigation Manual.*

Frost Protection

Irrigation systems can be used for frost protection in spring and autumn. Under-tree irrigation systems protect crops by raising the air temperature slightly above the freezing level. Over-tree irrigation systems offer more protection by encasing plant buds in ice, thereby preventing the bud temperature from dropping below the freezing level. (See the *BC Frost Protection Guide*.)

Crop Cooling

Irrigation systems can provide evaporative cooling to reduce plant or fruit temperature during the hottest part of the day. The application rates used for crop cooling systems are less than for irrigation. The systems are generally operated on a cycle of 1/3 on and 2/3 off. (See MAFF factsheet 578.300-1.)

Silviculture

Forest-seed, seedling, and seed-orchard production operations use overhead and drip irrigation systems for many types of production practices.

Greenhouses

Greenhouse irrigation systems include spray and mist systems for propagation areas, drip systems for food crops and some potted plant production, and flood or ebb-and-flow systems for floriculture and nurseries.

Landscape Irrigation

Landscape systems are often automated and can be categorized into three types of systems: sprinklers or rotors, spray heads, and drip.

- **Sprinkler Systems**

  In-ground rotors are usually used for landscape turf systems. The size of the rotor depends on the field size, type of turf (sports field, golf course, or landscape lawn), water supply, and pressure availability.

- **Spray Heads**

  Spray head systems are available in many patterns and can spray water up to 6 m. Spray heads are often used in small, narrow turf and landscape areas. They have a very high application rate and should therefore be operated for short durations (15 minutes or less) to prevent runoff.

- **Drip Systems**

  Point-source and spray-emitter drip/trickle systems are often used in landscape situations. (See chapter 15 of the *BC Trickle Irrigation Manual*.)

3.1.3 Considerations for Use

See MSR schedule 2 (*Permitted Uses and Standards for Reclaimed Water*) to determine the quality of effluent that may be used by the different systems on various crops and landscapes.

General Irrigation

- Irrigation shall be applied to provide crop water needs over an irrigation interval, providing an allowance for some leaching, but minimizing leaching to groundwater.
- Reclaimed water contains higher levels of metals than most fresh water supplies. Water samples should be taken to ensure that metals and specific ions do not exceed Canadian water quality guidelines.
- Reclaimed water may not be used in irrigation within 30 m of any well or in-ground reservoir used for domestic supply.
- There must be no surface runoff of reclaimed water from irrigated lands.
- Reclaimed water irrigation systems must be managed to minimize aerosol drift from irrigated land.
- Adequate disinfection (minimum chlorine residual of 0.5 mg/l) must be maintained in reclaimed water discharged from the disinfection system to the irrigation system.

Cross-connection Control

An approved backflow preventer must be used where a cross-connection might cause contamination of a potable water system. (See *Chemigation Guidelines for British Columbia* and BCMAF factsheet 578.130-1).

Crop Irrigation

Reclaimed water can have a beneficial nutrient content. Knowledge of nutrient uptake and removal by the crop is required to adjust fertilization programs to account for the nutrients supplied by the reclaimed water.

Category 1 reclaimed water may be applied:

- by sprinkler irrigation systems to forage, fibre, nursery, or turf crops
- with sprinkler systems to food crops that are commercially processed
- to crops that will be eaten raw, provided that the water does not contact the fruit or vegetable directly.

Drip and trickle systems must be used for sweet corn, berry, and fruit crops. Vegetable crops must be irrigated with a subsurface drip irrigation system. Root crops may not be irrigated with reclaimed water if they are likely to be eaten raw. Processed vegetables should be thoroughly washed and cooked.

Extra precautions should be taken with sweet corn and some cole crops. Water that accumulates inside the husks may not have an opportunity to drain away and may be shielded from the disinfecting effects of sunlight. There is greater potential for bacteria to grow under these conditions.

Considerations for the use of category 2 reclaimed water:

- Irrigation through sprinkler systems may only be applied to forage, fibre, nursery and turf, or food crops that are commercially processed.
- Trickle/drip irrigation systems may be used on orchard and vineyard crops provided that the reclaimed water does not contact the fruit.
- Category 2 reclaimed water must not be applied to crops that will be eaten raw, except for orchard and vineyard crops as qualified above.

Frost Protection

Spring frost protection may use category 1 or 2 reclaimed water, since the reclaimed water is used well before the crop is harvested. Autumn frost protection may be used on crops that are processed but not for crops that are eaten raw, since the application will generally be close to harvest. Only category 1 reclaimed water may be used in the autumn, since the application is often close to harvest.

For overhead irrigation systems used for frost protection, the system must be turned off as soon as water runs freely between the ice that has formed and the plant material.

Crop Cooling

Only category 1 reclaimed water may be used for crop cooling. Reclaimed water may only be used for crop cooling until 30 days before harvest of crops that are eaten raw.

Silviculture

Category 2 reclaimed water may be used if the silviculture operation is outdoors. Indoor use of category 2 reclaimed water requires a drip irrigation system. Spray or mist systems are more often used indoors. Aerosols may be developed, provided that category 1 reclaimed water be used for spray or mist systems indoors.

Greenhouses

Category 1 reclaimed water must be used for mist and spray systems in greenhouses. Category 2 reclaimed water is adequate for flood and drip systems.

Landscape Irrigation

Generally, landscape irrigation may only use category 1 reclaimed water. Category 2 reclaimed water may be considered for remote areas of parks, school grounds during vacation periods, and golf courses provided that:

- a minimum of 60 days storage is provided
- the discharger demonstrates to the satisfaction of the Regional Pollution Prevention Manager that access is controlled
- environmental concerns are addressed
- any concerns of the local health authorities are resolved
- the Regional Pollution Prevention Manager, in consultation with local health authorities, approves the use in writing.

Grazing Animals

Milking animals must be prohibited from grazing for 6 days after irrigation ceases. Other cattle must be prohibited from grazing for 3 days after irrigation ceases, unless their meat is inspected under the federal or provincial meat inspection program.

Soil Considerations

Irrigated land must be monitored to prevent soil saturation, surface erosion, and instability in the irrigated areas and downgradient of the irrigated lands.

While all water sources contain some salts, reclaimed water contains higher levels of salts than the fresh water supply. There is also a higher proportion of sodium in relation to other dissolved cations. The primary concerns for sodicity and salinity control in reclaimed water are:

- selecting crops properly
- ensuring adequate salt and specific ion tolerance of the crops to be irrigated
- ensuring satisfactory levels of salinity, sodicity, and specific ion concentrations in soil seed-bed during germination
- ensuring sufficient irrigation to allow for some leaching
- ensuring sufficient drainage to dispose of leaching water.

3.1.4 Specific Design Suggestions

In accordance with part 5 of the MSR, reclaimed water treatment and distribution systems must be designed by qualified professionals. The irrigation system itself should be designed by a professional engineer with experience in irrigation system design, or by a certified irrigation designer (CID) registered with the Irrigation Industry Association of British Columbia (IIABC).

Plans of modifications and/or extensions to existing works must be signed and sealed by a qualified professional. Retain a copy of all *as-built*, plans of modifications and/or extensions to the works for perusal by the Regional Pollution Prevention Manager, or her or his designate, upon request.

Design and construct irrigation works in accordance with best current practices. For agricultural irrigation systems, the design must also be in accordance with *The BC Sprinkler Irrigation Manual* of 1989 or *The BC Trickle Irrigation Manual* of 1999. Turf and landscape irrigation systems must be designed in accordance with standards established by the IIABC.

The purveyor of reclaimed water must provide the Regional Pollution Prevention Manager with an assessment of how much water can be applied to the site on an annual basis.

3.2 Chemical Spraying

Reclaimed water may be used for the purposes of chemical spraying where a sprayer filling station has been set up in accordance with the guidelines set out below. An agricultural producer who is supplied with reclaimed water may establish a sprayer filling station on the farm.

3.2.1 References

- *Handbook for Pesticide Applicators and Dispensers* - MELP
- *Pesticide Applicator Course for Agricultural Producers* - MAFF, MELP, AC
- *Environmental Guidelines* – (a guideline for each commodity) - MAFF

3.2.2 Description of Use

Reclaimed water may be used for chemical spraying with a boom, air blast, wick, or any other recognized application method.

3.2.3 Considerations for Use

The operator must follow standard protection practices as outlined in the references.

The sprayer filling station must be located at least 30 metres from any well or in-ground reservoir used for domestic supply purposes.

The sprayer filling station must be located at least 10 meters from all watercourses.

The sprayer filling station must clearly bear the message "reclaimed water is used".

3.2.4 Specific Design Suggestions

Maintain an air gap of 30 cm between the end of the filling hose and the top of the sprayer tank. Where an air gap is not possible, a reduced-pressure-principle backflow device should be installed.

3.3 Fire Fighting

Reclaimed water may be used for fire fighting.

3.3.1 References

- *Guidelines for Water Reuse*, USEPA/625/R-92/004
- *Florida Department of Environment Regulation* 17-610 (Re-use of Reclaimed Water and Land Application)
- A copy of the letter dated November 29, 1991 from BC Environment to the City of Vernon regarding the use of reclaimed water for fire fighting.

3.3.2 Description of Use

Reclaimed water may be used for both indoor and outdoor fire fighting.

3.3.3 Considerations for Use

Reclaimed water used for fire fighting must meet the criteria for category 1 reclaimed water, and must not contain any pathogens.

For outdoor fire fighting, fire hydrants using reclaimed water must be specially colour-coded and tagged to identify the water source.

Only reclaimed water supplies that are available year-round may be used for fire fighting.

Fire fighters and other emergency personnel must be made aware that reclaimed water is being used and any special training needs should be addressed.

Reclaimed water must not be used for indoor fire suppression sprinklers in food preparation areas such as restaurant kitchens.

Reclaimed water from regular flushing and maintenance of fire hydrants must not be directed into storm sewers, but must be directed into sanitary sewers or fields in rural areas.

3.3.4 Specific Design Suggestions

None.

3.4 Toilet and Urinal Flushing

The use of reclaimed water for toilet and urinal flushing is gaining acceptance in many parts of the world, particularly in areas short of water. Since toilet flushing accounts for approximately 30% of in-home water usage, the use of reclaimed water instead of potable water significantly reduces demand for potable water. It also provides an attractive use of reclaimed water and embraces recycling principles.

In commercial buildings, over 80% of the water used is for toilet and urinal flushing and air conditioning. These buildings have the greatest potential for using reclaimed water for toilet flushing. Multi-storey office buildings usually have toilet facilities located centrally on each floor. Thus, a common dedicated piping system carrying reclaimed water can easily be installed. Some water purveyors in the US now require new multi-storey commercial buildings to use reclaimed water for toilet and urinal flushing.

3.4.1 References

- *Dual Water Systems*, American Water Works Association, manual M24
- *Wastewater Reclamation and Reuse*, Asano Takashi, Technomic Publishing Co. Inc. ISBN 1-56676-620-6
- Proceedings from AWWA Water Reuse Conferences, 1996, 1998, and 2000

3.4.2 Description of Use

Category 1 reclaimed water may be used for toilet and urinal flushing, as outlined in schedule 2 of the MSR. The reclaimed water plumbing to the toilets and urinals must be properly labeled and colour-coded (Pantone 522).

3.4.3 Considerations for Use

Toilet and urinal flushing uses can only be approved with backflow prevention devices installed and tested as outlined in section 4.6.3 of this code.

Where commercial applications are practiced, adequate signage must be provided to inform the public that reclaimed water is used. All reclaimed water piping inside buildings must be properly labeled and colour-coded (Pantone 522).
Users must under no circumstances connect the reclaimed water supply to the potable water supply.

At this time, use of reclaimed water within single family dwellings is not recommended, unless specific measures, developed in consultation with MELP and the local health authority, are in place.

3.4.4 Specific Design Suggestions

None.

3.5 Ponds and Decorative Uses

Reclaimed water may be used for ponds and other outdoor decorative uses.

3.5.1 References

None.

3.5.2 Description of Use

Reclaimed water may be used in landscape water features such as artificial ponds and streams, fountains, and sheet water attractions – provided that the water is recirculated.

3.5.3 Consideration for Use

Because of the potential for coliform regrowth, continued disinfection is recommended. Disinfection also inhibits the growth of unsightly algae, which can occur because reclaimed water generally carries higher levels of nutrients than fresh water.

3.5.4 Specific Design Suggestions

When landscape features are drained, the water must not be discharged to stormwater sewers or any surface waterbody, except with prior written consent from the Regional Pollution Prevention Manager. The water may be discharged to an infiltration basin, a sanitary sewer, or a subsurface disposal system such as a dedicated tile field.

The inclusion of an automatic disinfection system, or inclusion of instructions on periodic shocking of the system with a disinfectant (e.g. chlorine granules), is recommended to enhance end-user satisfaction with water features.

3.6 Stream Augmentation

In some circumstances it may be environmentally beneficial to augment the natural flow of water in a stream with reclaimed water. This practice is separate and distinct from the discharge of effluent (i.e., non-reclaimed water) to water bodies with adequate dilution in accordance with schedule 3 of the MSR.

3.6.1 References

Schedule 2 of the MSR contains a list of permitted uses and standards for reclaimed water.

3.6.2 Description of Use

Reclaimed water is added to a stream to augment the natural flow of water in the stream. Only category 1 reclaimed water may be used for streamflow augmentation.

3.6.3 Considerations for Use

In cases where natural or remaining natural stream flow is insufficient to support the normal full spectrum of healthy aquatic life, reclaimed water may be used to supplement the water flow in a stream. The reclaimed water could be added during a low-flow period, such as the summer months, or it could be added year-round.

Reclaimed water quality requirements must be specified in an environmental impact study and meet with the approval of the Regional Pollution Prevention Manager. The reclaimed water must be non-toxic to aquatic life and must not adversely affect downstream uses or users (e.g. downstream domestic uses).

3.6.4 Specific Design Suggestions

With reference to section 13 of the MSR, it is probable that a high level of treatment will be required for stream flow augmentation. Provisions for phosphorus and nitrogen reductions are highly likely. The environmental impact study would need to consider the impact of nutrients on stream water quality and on any waterbodies downstream.

Infiltration of effluent into the ground for later extraction for streamflow augmentation may negate the need for disinfection of the effluent, and would lower the risk of impact on the stream in the event of a treatment facility upset.

3.7 Habitat restoration/enhancement

In some circumstances it may be environmentally beneficial to provide water to restore or enhance natural habitat. This may include streamflow augmentation as discussed in section 3.6 or other beneficial uses such as maintaining a wetland area.

3.7.1 References

None.

3.7.2 Description of Use

Reclaimed water of suitable quality may be used to supplement natural water in a program of habitat restoration or enhancement. Effluent that has been extracted from the ground might be considered reclaimed water and may also be used.

3.7.3 Considerations for Use

Reclaimed water might contain nutrients that could have a deleterious effect on downstream water quality. The temperature of the reclaimed water might also affect aquatic life in the stream. Improper addition of water to the stream could result in erosion of the stream bed or stream bank.

Habitat restoration/enhancement projects need to be examined individually and must stand on their own merit. The reclaimed water quality requirements must be specified in an environmental impact study and meet with the approval of the Regional Pollution Prevention Manager.

3.7.4 Specific Design Suggestions

An assessment conducted by a suitably qualified professional is required to ensure that the quality of the reclaimed water is acceptable for the intended use, and that there are no contaminants present, such as nutrients, that could adversely affect downstream water quality.

If the application is stream flow augmentation, then a stream flow augmentation plan must be prepared concurrently with the assessment to provide guidance regarding the method of stream flow augmentation. It should also recommend any mitigating measures, such as pre-aeration or the use of a surface holding pond to moderate water temperature.

The Regional Pollution Prevention Manager and other MELP personnel would be involved in the development of a project that used reclaimed water irrigation for habitat restoration and enhancement. Specific requirements would need to be developed for each project because the requirements would likely be site-specific.

3.8 Commercial Vehicle, Driveway and Street Washing

Category 1 reclaimed water may be used for commercial vehicle, and driveway and street washing. Equipment used for this purpose must not be used for distribution of potable water.

3.8.1 References

None.

3.8.2 Description of Use

Reclaimed water may be used for cleaning streets, sidewalks and commercial driveways.

Commercial car washes may also use reclaimed water. Special hose-bibs with fittings different from normal hose ends (quick-disconnect fittings) must be used in supplying reclaimed water for commercial vehicle washing.

3.8.3 Considerations for Use

Category 1 reclaimed water may be used for street washing. Tanker trucks containing reclaimed water must be adequately marked to show that reclaimed water is being used. Street cleaning should be done when the public is not likely to be present.

Hoses used for reclaimed water must not be used for potable water uses. Hose bibs must be colour-coded (Pantone 522) and marked to identify the source of water. Hoses must have a shut-off nozzle so that the supply is shut off when not being used.

If a chlorine residual greater than 1.0 mg/L is in the reclaimed water in street-cleaning tankers, then de-chlorination must be provided to protect fish and fish habitat. Regular public notices in local newspapers should inform the public that reclaimed water will be used in a street-washing program.

3.8.4 Specific Design Suggestions

None.

3.9 Snow and Ice Making

Reclaimed water may be used in snowmaking to supplement the natural snowfall.

The use of reclaimed water for making and re-surfacing recreational ice surfaces (e.g. skating and curling rinks) may also be considered in this section of the code.

3.9.1 References

Snowmaking study conducted at Kamloops (circa 1980).

3.9.2 Description of Use

Reclaimed water may be used in place of fresh water in snow-making machines prior to the beginning of the operating season for skiing and snowboarding. The intent would be to provide a base to help a snow-based recreational operation open for the season with a good snow base.

3.9.3 Considerations for Use

Only category 1 reclaimed water may be used for snowmaking for skiing or snowboarding.

Because snow made from category 1 reclaimed water may contain nutrients, ensure that the snow will not create or add to a nutrient problem in area streams or lakes.

Maintain records of the amount of reclaimed water used in snowmaking and where it is used. This information should appear in an annual report.

Snowmaking equipment must be adequately marked to show that reclaimed water is being used.

Ski passes where reclaimed water is used in snowmaking must state that reclaimed water is used.

Staff working at ski hills using reclaimed water must be made aware of the source of water used in snowmaking equipment.

3.9.4 Specific Design Suggestions

The freeze-thaw cycle tends to pass any contaminants in the snow down to the underlying soil. Contaminants in the snow travel vertically through the snow base to the ground underneath where renovation occurs during the freeze-thaw cycle. However, a rapid snowmelt could result in overland flow of meltwater. Therefore, it is prudent to ensure that snow from reclaimed water is applied prior to or early in the ski season, perhaps allowing an early start to the season.

A snowmaking operations plan prepared by a suitably qualified professional is required prior to snowmaking. This plan will identify the precise areas that would benefit from snowmaking and outline the procedures to be followed. Snow made from reclaimed water is not to be placed closer than 15 metres to a watercourse or waterbody.

3.10 Dust suppression and soil compaction

Reclaimed water may be used for dust suppression and soil compaction according to the criteria and guidelines here.

3.10.1 References

None.

3.10.2 Description of Use

Reclaimed water may be used for dust suppression and soil compaction when applied from a tank mounted on a moving vehicle.

3.10.3 Considerations for Use

The reclaimed water must be applied to the target area only, and there must be no runoff from the application.

Vehicles used for hauling reclaimed water should be dedicated to this purpose. Water to be used for drinking cannot be transported by a truck that has been used to haul reclaimed water. The vehicle must have signage stating that it uses reclaimed water.

3.10.4 Specific Design Suggestions

None.

3.11 Industrial Uses

Category 1 and category 2 reclaimed water may be used for industrial purposes including aggregate washing, concrete making, equipment washing, cooling towers (excluding evaporative cooling towers), stack scrubbing, boiler feed, and process water (excluding food processing).

3.11.1 References

None.

3.11.2 Description of Use

Reclaimed water may be used in construction and industrial processes noted in schedule 2 of the MSR. Uses such as aggregate washing and concrete making are often a once-only use with no special concerns. Other industrial uses (e.g. stack scrubbing, boiler feed, processing, cooling towers, equipment washing) may recycle the reclaimed water through the plant. Reclaimed water may be recycled and used repetitively in the same process or in more than one process.

3.11.3 Considerations for Use

Worker contact with reclaimed water must be minimal. A higher level of disinfection must be provided to achieve < 14/100 ml fecal coliform organisms where frequent worker contact with reclaimed water is likely.

Boiler feedwater may be subject to stringent quality requirements. Of particular concern are iron, copper, silica, and total dissolved solids. Check water quality criteria prior to using reclaimed water in boiler operations.

Regardless of category of reclaimed water is proposed for use, evaporative cooling towers are not permitted in residential or commercial areas because of concern over pathogen build-up over time.

3.11.4 Specific Design Suggestions

The provider of reclaimed water must consult the specific industry's recommended water quality limits for make-up water. An assessment conducted by a qualified professional may be required to ensure that the quality of the reclaimed water is acceptable for the industrial use intended.

4. Urban Dual Distribution (Non-Potable)

4.1 Preface

The use of dual distribution systems – one for potable water and another for non-potable water – is becoming an acceptable practice in many water-short areas. The main reasons for this are:

- diminishing high-quality water resources
- rapidly escalating costs for the development of new water sources and the treatment of poor-quality water
- the growing costs to treat sewage to increasingly stringent standards.

Developing a dual distribution system might be less costly and less wasteful than existing practices that use potable water for purposes that do not require potable water quality.

Properly treated and distributed non-potable water can be used for lawn and landscape irrigation and other non-potable urban water uses, provided that specific measures developed in consultation with MELP and the local health authority are in place.

4.2 Roles and Responsibilities

4.2.1 Reclaimed Water Providers

Providers of reclaimed water must ensure that the reclaimed water meets the criteria outlined in the MSR for the use intended. They must also obey local by-laws that outline policies and procedures for using reclaimed water. These by-laws must contain penalties for the improper use of reclaimed water, as well as clauses that limit providers' liability for improper use.

4.2.2 Purveyors

Purveyors are responsible for ensuring that delivery pipes and equipment used to supply reclaimed water are properly identified and marked. Purveyors must also ensure that adequate cross-connection control measures are in place. If the purveyor is also a supplier of potable water, then the purveyor must ensure that an approved backflow prevention device is installed at the potable water connection to reduce the risk of unintended cross-connections.

4.2.3 End-users

End-users must ensure that they use reclaimed water only for approved uses, and abide by the local by-law.

4.3 References

- *Dual Water Systems*, American Water Works Association, Manual M24, AWWA
- *Water Reuse*, Water Environment Research Foundation, Project 92-WRE-1, 1994
- *BC Building Code*

4.4 Description of use

Dual distribution involves the provision of two grades of water to the same service area – one potable and the other non-potable. The potable source is intended for human consumption while the non-potable source – highly treated wastewater – is acceptable for a wide range of other uses. The uses are determined by the process used, the reclaimed water quality, and the monitoring program.

4.5 Design and Installation Requirements

4.5.1 Building Code

Dual-distribution systems must conform with the provisions outlined in the *BC Building Code*.

4.5.2 Building Inspections

Plans for dual-distribution systems in buildings and irrigation systems must pass local inspections conducted by local building inspectors before they are approved.

4.5.3 Irrigation System Design and Installation

Irrigation systems applying reclaimed water in domestic areas must be designed in accordance with standards established by the IIABC (see § 3.1). Prior to installation, the property owner must submit irrigation system design plans to the municipality or purveyor. These plans must be designed by a professional engineer or sealed by a Certified Irrigation Designer (CID) registered with the IIABC in the discipline that pertains to the type of work intended.

The irrigation system must be installed by a contractor registered with the IIABC as a Class A Contractor in the discipline that pertains to the work being done. The two options for class A contractors are residential and commercial. The class A contractor is responsible for:

- ensuring that the irrigation system is installed as closely to the design plan as possible
- providing an irrigation schedule to the owner that provides guidance on how to operate the system and how the schedule changes through the irrigation season
- providing an as-built plan that accurately shows the locations of pipes, sprinklers, valves, and other equipment.

4.6 Equipment Considerations

4.6.1 Delivery Equipment

All piping, valves, meters, and irrigation equipment connected to a reclaimed water supply must bear the universal colour for reclaimed water (Pantone 522), and be identified as carrying reclaimed water according to AWWA guidelines for the distribution of non-potable water.

Construction of dual-distribution mainlines is subject to approval by the local health authority and must be installed in a manner that is consistent with Ministry of Health policy regarding watermain-sewer separation distances. A reclaimed water line can be installed in the same trench as a sanitary sewer line providing that the reclaimed line is installed above the sanitary sewer line.

Irrigation equipment must be operated to prevent drifting spray onto adjacent properties.

Reclaimed water systems must be metered.

Reclaimed water may only be applied using in-ground irrigation systems with pop-up heads, or drip irrigation systems. The system must be operated by a timer and scheduled to ensure that the application rate does not exceed the infiltration rate of the soil so that runoff does not occur.

Hose-bibs must not be connected to reclaimed water services.

4.6.2 Application Equipment

Irrigation

Sprinklers, spray heads, and drip/trickle irrigation systems can be used to apply reclaimed water to landscape areas on private lots. (See § 3.1.2.) Sprinkler and spray equipment must be permanent in-ground systems with pop-up heads. Drip emitters may be installed either above or below ground.

For garden areas, drip irrigation systems must be used for sweet corn, berry, and fruit crops to prevent reclaimed water from contacting the edible portion of the crop. Vegetable crops must be irrigated with a subsurface drip irrigation system. Root crops cannot be irrigated with reclaimed water if they are likely to be eaten raw. Processed vegetables should be thoroughly washed and cooked.

Irrigation equipment must be operated to prevent spray drift onto adjacent properties.

The irrigation system application rate must not exceed the infiltration rate of the soil or cause any surface runoff.

An automated irrigation system must be used where irrigation is used to apply reclaimed water to urban landscape or turf areas not supervised by a landscape professional. The irrigation controller must have a minimum of two start times per day, seven days per week. The *on* time for each station must be settable in one-minute increments.

Commercial or Residential Appurtenances

At this time, reclaimed water is not considered for toilets in residential buildings, unless specific measures developed in consultation with MELP and the local health authority are in place.

Hose-bibs must not be connected to reclaimed water services.

4.6.3 Cross-Connection Control

To protect the quality of potable water supplies, proper cross- connection control must be in place. Users must not under any circumstances connect the reclaimed water supply to the potable water supply.

Where reclaimed water is provided, the user must install an approved backflow prevention device on the potable water supply line. The backflow preventer device must be approved by the water purveyor and installed close to the point of connection to the water purveyor's distribution line in an easily accessible location. The device must be inspected annually by a certified tester, and a certificate of inspection shall be made available to the provider upon request.

4.7 Design Considerations

4.7.1 Winterizing

An irrigation system must have a winterization port at its connection to the reclaimed water distribution system, allowing an air compressor to drain the irrigation lines prior to winter. A shutoff valve must also be provided for winterizing the system.

4.7.2 Fire Fighting

Fire fighting may use reclaimed water, as outlined in section 3.3 of this code. The supply should be available year-round and the hydrants and related equipment should be clearly tagged and coloured to indicate the source of water.

4.7.3 Shutoff Requirements

The reclaimed water line to a residential or commercial lot must have a manual shutoff valve that is easily accessible to the property owner. The valve must be installed prior to the distribution system of reclaimed water to the property.

4.8 System Management

4.8.1 Hours of Operation

An irrigation system using reclaimed water in a residential area should be scheduled only to operate automatically between 10:00 PM and 6:00 AM.

5. Contingency Options For Surplus Reclaimed Water

This section contains general guidance. Providers of reclaimed water must refer to the appropriate sections of the MSR to ensure that any specific contingency measure for surplus reclaimed water meets MSR requirements.

Seasonal providers of reclaimed water who also seasonally discharge effluent to the environment must ensure that the discharge of effluent is registered in accordance with the MSR and meets the requirements of the MSR.

When reclaimed water is used for irrigation or other purposes it is crucial that an alternate (or contingency) system be available for reclaimed water that is surplus to the needs of the irrigation system or regular use. The contingency system would be utilized in accord with a pre-planned program that accommodates the possible impact of the discharge. The fill rate and water level information for the main reclaimed water storage reservoir might be used to establish a date to start use of the contingency facilities to prevent failure of the storage system. In addition, if the water comes directly from the treatment facility, then there must be contingency facilities capable of handling reclaimed water that temporarily may not meet the required standards and requirements for its use.

5.1 Subsurface disposal

In many circumstances, a subsurface disposal system makes a prime choice for the disposal of reclaimed water that is surplus to the needs of a water-reuse program. The requirements for this type of operation must be consistent with subsurface disposal systems specified under the MSR.

A hydrogeological assessment must appear in the discharger's environmental impact assessment. Conducted by a suitably qualified professional, the hydrogeological assessment must address soil stability, erosion, and environmental impact on-site and off-site resulting from the subsurface disposal activity. The report must include recommendations on the number and locations of groundwater sampling wells, at least one of which should be a *background* sampling well.

5.2 Infiltration Basins

The use of infiltration basins as the primary method to dispose of surplus reclaimed water from a water reuse program is generally encouraged. The requirements for this type of operation must be consistent with infiltration basin systems specified under the MSR. The use of multiple basins is encouraged, provided that there is a low enough frequency of dosing, so that a dose can infiltrate into the ground before the next dose is applied.

A hydrogeological assessment must appear in the discharger's environmental impact assessment. Conducted by a suitably qualified professional, the hydrogeological assessment must address soil stability, erosion, and environmental impact on-site and off-site resulting from the infiltration activity. The report must include recommendations on the number and locations of groundwater

sampling wells, at least one of which should be a *background* sampling well. The qualified professional must also develop an infiltration basin maintenance program.

5.3 Surface Water Discharge (Outfall)

An outfall can be a good way to dispose of reclaimed water surplus to a water reuse program. The requirements for this type of operation must be consistent with those specified under the MSR.

The discharger must provide an environmental assessment, conducted by a suitably qualified professional, that includes recommendations for a sampling and monitoring program.

5.4 Evaporation Basins

Evaporation is generally **not** encouraged as a primary method to dispose of surplus reclaimed water from a water reuse program. When a qualified professional can demonstrate that there is a propensity for greater evaporation losses than precipitation, evaporation basins may be considered for back-up contingency use only.

Reclaimed water flows in excess of evaporation losses may be discharged elsewhere, if a qualified professional can demonstrated to the Regional Pollution Prevention Manager that the reclaimed water has been satisfactorily renovated for the discharge method and location proposed. Good engineering must be used to maximize exposure to solar radiation while protecting the embankments from wave erosion. The report, prepared by a suitably qualified professional, must include a sampling and monitoring program acceptable to the Regional Pollution Prevention Manager.

5.5 Deep Well Injection

Deep well injection is generally discouraged as a primary method to dispose of reclaimed water that is surplus to the needs of a water reuse program. When a qualified professional can demonstrate that there is no viable alternative, deep well injection may be considered for back-up contingency use only.

The discharger must provide an environmental assessment, conducted by a suitably qualified professional, that includes recommendations for a sampling and monitoring program. A series of sampling wells to demonstrate the efficacy of the deep well injection program should be included in the sampling and monitoring program. Deep well injection proposals are reviewed by the Regional Pollution Prevention Manager in consultation with the local health authority (Medical Health Officer). Written authorization to proceed can only be obtained prior to construction.

6. Storage

The ability to store reclaimed water is required for:

- **irrigation purposes** – for times when the method of application is not continuous. Storage is required during the non-growing season. Schedule 7, note 6 of the MSR outlines storage requirements and storage design standards. The methodology for determining storage capacity appears here.
- **normal balancing (seasonal) storage** – for times when normal reclaimed water production exceeds reclaimed water usage (particularly for the winter non-irrigation season).
- **emergency storage** – for times when reclaimed water usage is unexpectedly interrupted, or the reclaimed water does not meet the quality standards that have been set.
- **storage for treatment**
  - ⇒ for the substitution of storage, in lieu of filtration, for producing category 1 reclaimed water, as outlined in note 4, appendix 1 to schedule 2 of the MSR.
  - ⇒ for the use of category 2 reclaimed water for the irrigation of remote areas of parks, school grounds, and golf courses as outlined in note 6, appendix 1 to schedule 2 of the MSR.

6.1 Irrigation Purposes

For irrigation, the storage facility must be large enough to contain the average daily reclaimed water flow occurring outside the normal irrigation season.

The normal irrigation season is defined as the time when irrigation is required because of a climatic moisture deficit during the growing season. It is estimated from the length of the normal growing season, climatic trends, the annual climatic moisture deficit, and knowledge of irrigation periods in BC. The reference guide *Irrigation System Design for Reclaimed Water* (MAFF) provides information on the normal growing season, climatic moisture deficit, and estimated normal irrigation period for various regions in BC.

6.1.1 Wet Climates

The storage facility may have to provide an allowance for cumulative volumes of reclaimed water because of reduced irrigation in wet weather. If the average seasonal irrigation requirements (as outlined in *Irrigation System Design with Reclaimed Water*) are used to determine the irrigation area, then this is not necessary. If the land base area is not sufficient to accommodate the average seasonal irrigation requirement, then a cumulative capacity of five years of wet weather for a five-year return period should be added to storage.

6.1.2 Restricted Public Access

In addition, for restricted public access the number of irrigation days may be reduced due to the grazing of animals or harvesting of crops. (See schedule 7, item 6.3b of the MSR.) If the irrigated site is large enough to allow for the rotation of irrigation applications to accommodate the requirements for restricted public access there will not be additional implications for storage. If not, the reduced number of irrigation days must be subtracted from the normal irrigation period shown in the reference guide *Irrigation System Design for Reclaimed Water*.

6.1.3 Frost Protection

While frost protection is an acceptable use and can allow reclaimed water use earlier in the spring or later in the autumn than normal irrigation, frosts cannot be predicted and cannot be relied upon for reclaimed water use every year. An estimate of reclaimed water use for frost protection can be made and added to the storage volume calculation for the purposes of ensuring adequate supply. The *BC Frost Protection Guide* provides further information.

6.1.4 Crop Cooling

Crop cooling does not add enough moisture to the soil to mitigate the climatic moisture deficit. Therefore, crop cooling requires water additional to the irrigation supply. Crop cooling needs should be estimated and included in the design of the storage facility to ensure adequate supply. The MAFF fact sheet *Irrigation for Tree Fruit Cooling* (1995) provides additional information.

6.1.5 Supplementary Water

Freshwater irrigation supplies often have a water shortage later in the irrigation season when stream and groundwater sources decline. Reclaimed water can augment these supplies in some regions. An estimate of the amount of reclaimed water needed must be calculated and added to the storage volume. While this supplemental irrigation water may not be required each year, it must be accounted for if it is part of a water supply plan.

6.2 Normal Balancing (Seasonal) Storage

Normal seasonal storage capacity needs to be available for periods when reclaimed water production exceeds use. If the use is irrigation, then prepare for the normal 25-year wet-year cycle for the irrigation season, plus 20 days storage as a safety factor. Storage volume calculations should factor in evaporation from open water as well as enhanced evaporation, if provided for in the design.

6.3 Emergency Storage

If emergency disposal is not available, emergency storage must be available throughout the year. Storage volume should be enough to retain 75% of the normal reclaimed water production for a period of at least 20 days. Emergency storage capacity must be available in addition to normal seasonal storage but may be combined with seasonal storage in seasonal storage basins.

6.4 Storage for Treatment

In non-irrigation applications, 60 days storage capacity should be available for quality reasons outlined under *General Considerations*, unless chemical addition or filtration and appropriate disinfection are applied.

For irrigation, a 60-day storage period is required for the restricted public access category for remote areas of parks, school grounds, and golf courses. The Regional Pollution Prevention Manager might impose additional requirements.

6.4.1 Multiple storage reservoirs

Using multiple storage reservoirs is encouraged.

6.4.2 Improved water quality

The storage of reclaimed water improves its characteristics in several ways – the most important of which is bacteriological decay. In BC, 60 days reclaimed water storage plus disinfection is considered sufficient for water reuse for most beneficial uses.

6.4.3 Inlet/Outlet Arrangements

The flow to and from storage needs to be designed to minimize short-circuiting.

6.4.4 Maintenance of Quality

Consider artificial aeration in deep storage basins to minimize stratification and odours and to prevent oxygen depletion.

7. Monitoring

7.1 Monitoring of Reclaimed Water Quality

The monitoring requirements for the use of reclaimed water appear in appendix 1 to schedule 2 of the MSR. Also in schedule 6 are the monitoring requirements for discharges to water and ground. A reduction in monitoring requirements may be requested of the Regional Pollution Prevention Manager after a minimum of two full years of successful, stable operation.

7.2 Receiving Environment Monitoring

Receiving environment monitoring must be established in accordance with section 27 of the MSR.

7.3 Preventive Measures

7.3.1 Medical Health Officer Requirements

There are three monitoring requirements of particular interest to the Medical Health Officer:

- initial requirements
- ongoing requirements
- outbreak or contingency monitoring.

Purveyors of reclaimed water are responsible to expeditiously notify both the Regional Pollution Prevention Manager and the Medical Health Officer in the event of a breakdown in the treatment process that could affect the quality of the reclaimed water.

7.3.2 Initial Monitoring Requirements

Initial monitoring requirements are intended to show that the reclaimed water quality is equal to or better than its intended use (restricted or unrestricted public access). The quality and monitoring requirements are detailed in the MSR, schedule 2 and its appendix.

7.3.3 Ongoing Monitoring Requirements

Ongoing monitoring requirements are intended to assure that the quality of reclaimed water is equal to or better than required for its intended use. These requirements are less onerous than the initial monitoring requirements and are detailed in the MSR, schedule 2 and its appendix. When reclaimed water does not meet the quality requirements, remedial action must be implemented and initial monitoring requirements reinstated.

7.3.4 Outbreak or Contingency Monitoring Requirements

Outbreak monitoring requirements would be instituted in the event of an outbreak of disease as required by the Medical Health Officer. Contingency monitoring may be required by the Medical Health Officer if, in her or his opinion, there is a need to monitor beyond the requirements detailed in the MSR, schedule 2 and its appendix. Examples of contingency situations are provided in section 11 of this code.

8. Labelling, Signage, and Fencing

Labelling and signage are needed to advise workers and the general public that reclaimed water is being used and that certain precautions are necessary. Fencing is required to control access when category 2 reclaimed water is used in irrigation.

8.1 Signage

A suitable sign must be erected at the main entrance to the reclaimed water storage reservoir, evaporation basins, and infiltration site. It must bear emergency contact phone numbers

Prominent no trespassing signs, acceptable to the Regional Pollution Prevention Manager, must appear around the reclaimed water storage reservoirs advising that the water is not potable. The wording must be in language or symbols readily comprehensible by the general public, e.g. *NO TRESPASSING - RECLAIMED WATER - DO NOT DRINK.*

Prominent no trespassing signs, acceptable to the Regional Pollution Prevention Manager, must be erected around agricultural and silvicultural sites irrigated with reclaimed water, warning of the possible health hazard during the irrigation season and advising that the water used for irrigation is not potable. The wording must be in language or symbols readily comprehensible by the general public. e.g. *NO TRESPASSING - RECLAIMED WATER - DO NOT DRINK.*

Golf score cards must indicate that reclaimed water is used for irrigation on golf course lands.

8.2 Fencing

A chain-link security fence at least 6 feet high or functional equivalent is required around reclaimed water storage reservoirs to prevent public access. Also, a suitable fence must be erected and maintained around all areas irrigated with category 2 reclaimed water.

9. Records And Reporting

Those using or disposing of reclaimed water are required to monitor and submit reports on the effects of the reclaimed water to the Regional Pollution Prevention Manager. Depending upon the size of the operation, there might be a requirement to submit data two or four times per year, in accord with schedule 6 of the MSR. An annual report is also required.

9.1 Maintenance of Records

Maintain records of monitoring data as required for inspection by the Regional Pollution Prevention Manager or her or his designate.

9.2 Assessment of New Areas To Be Irrigated

An assessment of any area to be irrigated must be performed by a suitably qualified professional (agrologist or pedologist), using best current climate and soils data to substantiate that the land is capable of accepting reclaimed water for irrigation. This assessment must include any suggested restrictions or recommendations that the qualified professional deems necessary, including any further assessments.

This soils assessment must be submitted to the Regional Pollution Prevention Manager for review, prior to the initial commencement of irrigation on the site in question. Further review and ongoing soils assessments are to be conducted in accordance with the qualified professional's recommendations or as may be required by the Regional Pollution Prevention Manager. Information required annually should appear in the annual report.

9.3 Assessment of New Uses of Reclaimed Water

An assessment of any new use of reclaimed water must be performed by a suitably qualified professional who can substantiate that the reclaimed water is suitable for the proposed use. This assessment must include any suggested restrictions or recommendations that the qualified professional deems necessary, including any further assessments.

This assessment must be submitted to the Director of the Pollution Prevention and Remediation Branch for review prior to the initial commencement of the new use. Further review and ongoing assessments are to be conducted in accordance with the qualified professional's recommendations and as may be required by the Director.

9.4 Annual Performance Report

In additional to regularly submitting monitoring data, providers of reclaimed water must submit a yearly report to the Regional Pollution Prevention Manager that includes a summary of the results of all sampling and monitoring programs. Data interpretation and trend analyses should be provided where appropriate. The overview or executive summary should contain a table of the specific occasions, if any, when the operation was not in compliance with the MSR.

The report must confirm that each of the users of the reclaimed water was informed as to the requirements for use of reclaimed water prior to the irrigation season that year.

It is strongly recommended that a special handout be provided to each user. A copy of the handout should be included as one of the appendices in the annual report.

The report must also contain an appendix wherein the substance of all complaints received during the year are listed, with remedial action taken and appropriate comments.

The report is due within 60 days of the end of the calendar year for that year's monitoring. Raw data, suitably tabulated, are to be attached as appendices to the report.

The report is to be in a format suitable for review by the public and government agencies – in electronic and printed format satisfactory to the Regional Pollution Prevention Manager.

10. Communications

The introduction of the new regulation and guidelines and this code mean that regulators, generators, providers, and end-users of reclaimed water need to communicate effectively with the general public. A communications plan is essential for positive relations with the public.

In these times, any departure from accepted practices is potentially subject to public resistance. Businesses that want to introduce reclaimed water as a substitute for current water sources might encounter this. Therefore, communications planning that anticipates potential resistance from the public should accompany the introduction of reclaimed water usage.

Any party considering using reclaimed water and any regulator encouraging its use should develop a complete communications plan. The plan should begin with either a review of an existing communication strategy or preparation of a new one. The plan should identify end-users and other affected parties, what opposition might arise from them, and whose support is needed to gain public acceptance for the intended use.

The communications plan should address these considerations:

- What do we know about the customers who will be affected by the introduction of reclaimed water usage? Can we identify them specifically?
- What communication have we had so far with this group?
- What information do we have on this group's perception and understanding of reclaimed water issues? How have we reacted, to date, to their level of understanding?
- How can we alleviate the potential for negative reactions to the proposed use of reclaimed water (within the immediate community and further afield)?
- How can public acceptance be fostered proactively, before potentially negative reactions can take hold?
- Is the timing current? Are we at the front end of the issue or following already-formed public perception?

Once the information has been gathered, establish an action plan to address concerns that could arise. The plan should build on what has been learned elsewhere. Identify the key steps taken to raise an appropriate level of community understanding and acceptance of the use of reclaimed water. How were public perceptions monitored? What steps could counter misconceptions effectively? What role did education play in gaining acceptance elsewhere?

Awareness of the benefits of using reclaimed water and of the safety measures associated with its use are critical in dispelling public concern. Information on benefits and safety measures should be ready prior to queries from the public or the media.

Because public acceptance is critical to the ongoing use of reclaimed water, it warrants attention and effort. The engineering aspects of using reclaimed water may indeed be simple compared to managing public opinion, but with a good communications plan, resistance can be avoided and the safe and beneficial use of reclaimed water can proliferate.

10.1 Elements of a Communications Plan

Strategic communication is a necessity in water reclamation projects and must be an integral part of the overall planning process. Proactive communications enable proponents of reclaimed water usage to manage various challenges successfully that could otherwise become significant public relations issues.

These approaches are fundamental to successful strategic communication:

- start public education early
- establish an adequate communications budget
- identify target audiences, including all groups and any specific interests
- ensure on-going public education and outreach
- know your opposition
- create a simple, clear message
- frame the issues with care
- use polling
- develop a wide array of communication tools.

Depending on their own communications capabilities, proponents should consider taking advice from an experienced communications consultant to meet their specific needs.

11 Emergency Response Plan

Providers of reclaimed water must prepare and maintain an up-to-date emergency response plan documenting procedures to be followed in emergencies.

11.1 Plan Contents

The emergency response plan should identify:

- diversion to contingency procedures (§ 5 and 6 of this code)
- shut-down procedures including identification of safety issues and safety precautions for responding personnel
- communication networks to be used
- notification procedures including contact names and telephone numbers for local government, MELP, MAFF, and local medical health officials
- appropriate corrective or abatement measures including stopping the distribution of any unfit reclaimed water or containing or redirecting unfit reclaimed water to approved disposal facilities
- measures to mitigate any damage that might have been caused
- environmental or health risks (e.g. the potential for contaminating drinking water)
- media relations plan.

The provider of reclaimed water must:

- appoint one person and at least one alternate to act as an Emergency Response Co-ordinator with authority to act in accordance with the emergency response plan
- provide a copy of the emergency response plan to the Emergency Response Co-ordinator and each alternate, local government, MELP, MAFF, and local medical health officials.

11.2 Potential Emergency Situations

Providers of reclaimed water should identify potential emergency situations and design their emergency response plans accordingly. The plan should provide for an escalating approach to address:

- relatively minor situations (e.g. dealing with complaints regarding a broken irrigation line that allows reclaimed water to drain into a neighbouring swimming pool, or the spray from an irrigation system drifting over a neighbour's backyard barbecue)
- more urgent situations (e.g. a treatment system problem that allows inadequately treated water into the reclaimed water distribution system)
- critical situations (e.g. a treatment system problem that allows inadequately treated water to be sprayed onto an agricultural food crop).

Providers of reclaimed water must consult with local government, MELP, MAFF, and local medical health officials to determine appropriate responses to emergency situations. *Relatively minor* situations might not be health hazards and might be appropriately addressed as mere nuisances. *Critical* situations constitute potential health hazards and might require an immediate public health warning or food recall. *Urgent* situations might require remedial measures such as cleaning distribution lines, additional monitoring, and end-user or public notification.

12. Resources

12.1 BC Environment Regional and Headquarters Offices

BC Environment Regional and Sub-Regional Offices

1) BC Environment
Vancouver Island Regional Office
2080-A Labieux Road
Nanaimo, BC, V9T 6J9

Tel: (250) 751-3100
Fax: (250) 751-3103
Attention: Pollution Prevention Manager

2) BC Environment
Lower Mainland Regional Office
10470 152nd Street
Surrey, BC, V3R 0Y3

Tel: (604) 582-5200
Fax: (604) 582-5334
Attention: Pollution Prevention Manager

3) BC Environment
Southern Interior Regional Office
1259 Dalhousie Road
Kamloops, BC, V2C 5Z5

Tel: (250) 371-6200
Fax: (250) 828-4000
Attention: Pollution Prevention Manager

4) BC Environment
Penticton Office
201 - 3547 Skaha Lake Road
Penticton, BC, V2A 7K2

Tel: (250) 490-8200
Fax: (250) 492-1314
Attention: Pollution Prevention Officer

5) BC Environment
Kootenay Regional Office
401 - 333 Victoria Street
Nelson, BC, V1L 4K3

Tel: (250) 354-6355
Fax: (250) 354-6367
Attention: Pollution Prevention Manager

6) BC Environment
Kootenay Sub-Regional Office
205 Industrial Road G
Cranbrook, BC, V1C 6H3

Tel: (250) 489-8510
Fax: (250) 489-8506
Attention: Pollution Prevention Officer

7) BC Environment
Omineca-Peace Regional Office
1011 - 4th Avenue
Prince George, BC, V2L 3H9

Tel: (250) 565-6155
Fax: (250) 565-6629
Attention: Pollution Prevention Manager

8) BC Environment
Cariboo Regional Office
150 North 1st Avenue
Williams Lake, BC, V2G 4T1

Tel: (250) 398-4533
Fax: (250) 398-4296
Attention: Pollution Prevention Manager

9) BC Environment
Skeena Regional Office
3726 Alfred Street Bag 5000
Smithers, BC, V0J 2N0

Tel: (250) 847-7260
Fax: (250) 847-7591
Attention: Pollution Prevention Manager

BC Environment Victoria Headquarters	
Mailing Address:	Delivery address:
BC Environment Pollution Prevention & Remediation Branch Box 9342 Stn Prov Govt Victoria, BC V8W 9M1 Attention: MSR Contact Tel: (250) 387-6663	BC Environment Pollution Prevention & Remediation Branch 3 – 2975 Jutland Road Victoria, BC V8T 5J9 Attention: MSR Contact Fax: (250) 953-3856

12.2 BC Ministry of Agriculture, Food and Fisheries

Resource Management Branch
1767 Angus Campbell Road
Abbotsford, BC, V3G 2M3
Tel: (604) 556-3100
Fax: (604) 556-3099

12.3 Local Health Authorities

Capital Health Region 1900 Richmond Avenue Suite 430 Victoria, BC, V8R 4R2 Tel.: (250) 519-7066 Fax: (250) 519 7079 Medical Health Officer	Cariboo Community Health Services Society 540 Borland Street 3rd Floor Williams Lake, BC, V2G 1R8 Tel.: (250) 398-4600 Fax: (250) 398-4249 Medical Health Officer
Central Vancouver Island Health Region 495 Dunsmuir Street Suite 610 Nanaimo, BC, V9R 6B9 Tel.: (250) 755-3010 Fax: (250) 755-7353 Medical Health Officer	Coast Garibaldi CHSS Box 78 - 494 S Fletcher Road Gibsons, BC, V0N 1V0 Tel.: (604) 886-5600 Fax: (604) 886-2250 Medical Health Officer Tel.: (604) 886-5620
East Kootenay CHSS 1212 - 2nd Street N Cranbrook, BC, V1C 4T6 Tel.: (250) 426-1385 Fax: (250) 426-1384 Medical Health Officer Tel.: (250) 426-1399	Fraser Valley Health Region 34194 Marshall Road Abbotsford, BC, V2S 5E4 Tel.: (604) 556-5060 Fax: (604) 556-5077 Medical Health Officer Tel.: (604) 556-5060

Kootenay Boundary CHSS 813 10th Street Castlegar, BC, V1N 2H7 Tel.: (250) 365-4300 Fax: (250) 365-4303 Chief Executive Officer/Medical Health Officer Tel.: (250) 365-4344	*North Okanagan Health Region* 1440 - 14th Avenue Vernon, BC, V1B 2T1 Tel.: (250) 549-5714 Fax: (250) 549-5468 Chief Environmental Health Officer Tel.: (250) 549-5700
North Shore Health Region Community Health Services 132 West Esplanade 5th Floor North Vancouver, BC, V7M 1A2 Tel.: (604) 983-6700 Fax: (604) 983-6839 Medical Health Officer	North West Community Health Services Society 3412 Kalum Street Terrace, BC, V8G 4T2 Tel.: (250) 638-2220 Fax: (250) 638-2251 Chief Environmental Health Officer
Northern Interior Regional Health Board 2000 15th Avenue 4th Floor Prince George, BC, V2L 3G6 Tel.: (250) 565-2649 Fax: (250) 565-2640 Medical Health Officer Tel.: (250) 565-7461 1600 3rd Ave 4th Floor Prince George, BC, V2L 3G6 Tel.: (250) 565-2649 Fax: (250) 565-2640	Okanagan Similkameen Health Region Corporate Building 2180 Ethel Street Kelowna, BC, V1Y 3A1 Tel.: (250) 862-4010 Fax: (250) 862-4201 Medical Health Officer Tel.: (250) 862-4217
Peace Liard CHSS 1001 - 110th Avenue Dawson Creek, BC, V1J 4X3 Tel.: (250) 784-2400 Fax: (250) 784-2413 Chief Environmental Health Officer	Simon Fraser Health Region 4946 Canada Way Suite 400 Burnaby, BC, V5G 4H7 Tel.: (604) 294-7292 Fax: (604) 294-7505 Medical Health Officer Tel.: (604) 294-7444

South Fraser Health Region Regional Office 14265 - 56th Avenue Surrey, BC, V3X 3A4 Tel.: (604) 572-2600 Fax: (604) 594-0949 Medical Health Officer	Thompson Health Region Regional Office 519 Columbia Street 2nd Floor Kamloops, BC, V2C 2T8 Tel.: (250) 828-4402 Fax: (250) 828-4426 Medical Health Officer Tel.: (250) 828-4403 Fax: (250) 828-4636
Upper Island Central Coast CHSS 480 Cumberland Road Courtenay, BC, V9N 2C4 Tel.: (250) 334-1140 Fax: (250) 334-1182 Medical Health Officer and A/District Manager, Environmental Health Tel.: (250) 334-1141	Vancouver/Richmond Health Board 1060 W 8th Avenue Vancouver, BC, V6H 1C4 Medical Health Officer Tel.: (604) 736-2033 Fax: (604) 734-7897

Provincial Health Officer
http://www.health.gov.bc.ca/Tel.o/

12.4 Web sites

Pollution Prevention (MELP)

This Code of Practice
http://www.elp.gov.bc.ca/epd/epdpa/mpp/cop_reclaimedwater.doc

Municipal Sewage Regulation (MSR) Homepage
http://www.elp.gov.bc.ca/epd/epdpa/mpp/msrhome.html

Guidance on MSR
http://www.elp.gov.bc.ca/epd/epdpa/mpp/gomsr.html

Water Management (MELP)

Water (general)
http://www.elp.gov.bc.ca/wat

Water Quality (objectives, guidelines)
http://www.elp.gov.bc.ca/wat/wq/wqhome.html

Groundwater (aquifers, well locations)
http://www.elp.gov.bc.ca/wat/gws/gwis.html

Water Licences (locations)
http://www.elp.gov.bc.ca/wat/wrs/surfaces.html

Ministry of Agriculture, Food and Fisheries
http://www.agf.gov.bc.ca

12.5 Other Reference Materials

Ministry of Agriculture, Food and Fisheries

- Chemigation Guidelines for British Columbia (1993) - MAFF 578.100-1
- Irrigation System Cross Connection Control - MAFF Factsheet 578.130-1
- B.C. Frost Protection Guide (1988) - MAFF 670.100-1
- Using Irrigation for Tree Fruit Cooling (1995) - MAFF Factsheet 578.300-1
- Guide to Irrigation System Design with Reclaimed Water - MAFF 595.000-1
- Irrigation Scheduling Techniques - MAFF Factsheet 577.100-1
- Irrigation Scheduling with Tensiometers - MAFF Factsheet 577.100-2
- Evapotranspiration Rates for Turf Grass in B.C. - MAFF Factsheet 563.600-1

Irrigation Industry Association of British Columbia

- *The BC Sprinkler Irrigation Manual* (1989) - IIABC
- *The BC Trickle Irrigation Manual* (1999) – IIABC
- *Determining the Irrigation Requirement for Turf and an Irrigation Schedule* – IIABC

Others

- *Irrigation with Reclaimed Municipal Wastewater - A Guidance Manual*, Lewis Publishers Inc., Chelsea, Minnesota
- *Handbook for Pesticide Applicators and Dispensers* - MELP
- *Pesticide Applicator Course for Agricultural Producers* - MAFF, MELP, AC
- *Environmental Guidelines* – a guideline for each commodity – MAFF
- *Guidelines for Water Reuse*, USEPA/625/R-92/004
- Florida Department of Environment Regulation 17-610: *Re-use of Reclaimed Water and Land Application*

12.6 List of Abbreviations

MAFF	BC Ministry of Agriculture, Food and Fisheries
MELP	BC Ministry of Environment, Lands and Parks
MSR	Municipal Sewage Regulation
IIABC	Irrigation Industry Association of British Columbia (tel. (604) 859-8222)